

## CLAIMS

1. A non-thermal plasma reactor element comprising:  
a structural carrier;  
an electrode layer disposed upon said structural carrier;  
a thin high k barrier layer disposed upon said electrode layer and  
5 configured to form a non-thermal plasma reactor element;  
wherein structural support function is substantially provided by  
said structural carrier; and dielectric barrier function is substantially provided  
by said high k barrier layer.

2. The non-thermal plasma reactor element of claim 1,  
wherein said structural carriers comprise double dielectric barrier structural  
carriers, single dielectric barrier structural carriers, or a combination  
comprising double dielectric barrier carriers and null dielectric barrier structural  
5 carriers.

3. The non-thermal plasma reactor element of claim 2,  
wherein said double dielectric barrier structural carriers comprise an electrode  
layer disposed on opposite sides of said structural carrier; and a thin high k  
barrier layer disposed on each of said electrode layers.  
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4. The non-thermal plasma reactor element of claim 2,  
wherein said single dielectric barrier structural carriers comprise an electrode  
layer disposed on opposite sides of said structural carrier; and a thin high k  
barrier layer disposed on one of said electrode layers.  
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5. The non-thermal plasma reactor element of claim 2, wherein said null dielectric barrier structural carriers comprise an electrode layer disposed on opposite sides of said structural carrier wherein said null dielectric barrier structural carriers are high k dielectric barrier free.

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6. The non-thermal plasma reactor element of claim 1, wherein said electrode layer and said high k barrier layer are tailored to have dimensions as thin as possible for the particular NTP reactor application.

7. The non-thermal plasma reactor element of claim 1, further comprising:  
an intermediate bonding layer disposed between said structural carriers and said electrode layer.

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8. The non-thermal plasma reactor element of claim 1, wherein said structural carrier is prepared from a dielectric having properties sufficient to provide a suitable combination of low cost, fabricability, mechanical strength and thermal properties.

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9. The non-thermal plasma reactor element of claim 8, wherein said structural carrier comprises cordierite, mullite, or alumina.

10. The non-thermal plasma reactor element of claim 1, wherein said high k barrier layer comprises a high k material having less than about 5% porosity.

11. The non-thermal plasma reactor element of claim 10, wherein said high k barrier layer is bismuth strontium titanate, bismuth titanate, bismuth niobium titanate, or barium strontium titanate.

12. The non-thermal plasma reactor element of claim 1, wherein said high k barrier layer is doped.

13. The non-thermal plasma reactor element of claim 1, wherein said structural carrier is a plate structural carrier, C-shaped structural carrier, a planar structural carrier, a swept-shaped structural carrier, or a comb-shaped structural carrier; and further wherein

5                   said element comprises double dielectric barrier structural carriers, single dielectric barrier structural carriers, or a combination comprising double dielectric barrier carrier and null dielectric barrier structural carriers.

14. The non-thermal plasma reactor element of claim 13, wherein said element comprises a double dielectric carrier and minimal structural ligaments.

15. A non-thermal plasma reactor including a reactor element comprising:

5                   a structural carrier comprising double dielectric barrier structural carriers, single dielectric barrier structural carriers, or a combination comprising double dielectric barrier carriers and null dielectric barrier structural carriers;

wherein structural support function is substantially provided by said structural carrier; and dielectric barrier function is substantially provided by a high k barrier layer.

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16. The non-thermal plasma reactor of claim 15, comprising elements selected from the group consisting of plate structural carriers, C-shaped structural carriers, planar structural carriers, swept-shaped structural carriers, and inter-digitized tine elements prepared from comb-shaped structural carriers.

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17. The non-thermal plasma reactor of claim 16, wherein said element comprises a double dielectric carrier and minimal structural ligaments.

18. A method for preparing a non-thermal plasma reactor element comprising:

disposing an electrode layer upon a structural carrier comprising a double dielectric barrier structural carrier, a single dielectric barrier structural carrier, or a combination comprising a double dielectric barrier carriers and a null dielectric barrier structural carrier;

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disposing a high k barrier layer upon said electrode layer so as to form a non-thermal plasma reactor element; wherein

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structural support function is substantially provided by said structural carrier; and dielectric barrier function is substantially provided by a high k barrier layer.

19. The method of claim 18, further comprising:

disposing an intermediate bonding layer between said structural carrier and said electrode layer.

20. The method of claim 18, further comprising:  
doping said high k barrier layer.

21. The method of claim 18, wherein said structural carrier is a plate structural carrier, a C-shaped structural carrier, a planar structural carrier, a swept-shaped structural carrier, or a comb-shaped structural carrier.

22. The method of claim 18, wherein said electrode layer and a high k barrier layer are tailored to have dimensions as thin as possible for the particular NTP reactor application.

23. The method of claim 18, further comprising:  
preparing a minimal number of structural ligaments so as to maximize conversion efficiency while maintaining structural and electrical performance.

24. A null dielectric barrier structural carrier non-thermal plasma reactor element comprising:  
a null dielectric barrier structural carrier comprising a base dielectric structural carrier; and an electrode layer disposed on opposite sides of said structural carrier;

wherein said structural carrier is a plate structural carrier, a C-shaped structural carrier, a planar structural carrier, a swept-shaped structural carrier, or a comb-shaped structural carrier.

10      said null dielectric barrier structural carrier being high k barrier layer free.

25.      The null dielectric barrier structural carrier non-thermal plasma reactor element of claim 24, further comprising:

5              a plurality of null dielectric structural carriers stacked with discrete spacers disposed to form exhaust passages between adjacent carriers.

26.      The null dielectric barrier structural carrier non-thermal plasma reactor element of claim 24, further comprising:

5              a plurality of C-shaped null dielectric barrier structural carriers stacked together in an orientation forming exhaust passages between adjacent c-shaped carriers; and further wherein  
                 said element is discrete spacer free.

27.      The null dielectric barrier structural carrier non-thermal plasma reactor element of claim 24, wherein said structural carrier is prepared from a dielectric having properties sufficient to provide a suitable combination of low cost, fabricability, mechanical strength and thermal properties.

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28.      The null dielectric barrier structural carrier non-thermal plasma reactor element of claim 27, wherein said structural carrier comprises cordierite, mullite, or alumina.

29. A null dielectric barrier structural carrier non-thermal plasma reactor comprising

a null dielectric barrier structural carrier comprising a base dielectric structural carrier; and an electrode layer disposed on opposite sides of said structural carrier;

wherein said structural carrier is a plate structural carrier, a C-shaped structural carrier, a planar structural carrier, a swept-shaped structural carrier, or a comb-shaped structural carrier.

said null dielectric barrier structural carrier being high k barrier layer free.

30. The null dielectric barrier structural carrier non-thermal plasma reactor of claim 29, further comprising:

a plurality of null dielectric structural carriers stacked with discrete spacers disposed to form exhaust passages between adjacent carriers.

31. The null dielectric barrier structural carrier non-thermal plasma reactor of claim 29, further comprising:

a plurality of C-shaped null dielectric barrier structural carriers stacked together in an orientation forming exhaust passages between adjacent c-shaped carriers; and further wherein

said element is discrete spacer free.

32. The null dielectric barrier structural carrier non-thermal plasma reactor of claim 29, wherein said structural carrier is prepared from a dielectric having a suitable combination of low cost, fabricability, mechanical strength and thermal properties.

33. The ~~pull dielectric barrier structural carrier non-thermal~~  
plasma reactor of claim 32, wherein said structural carrier comprises cordierite,  
mullite, or alumina.

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